UNITED STATES PATENT AND TRADEMARK OFFICE

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Please find below and/or attached an Office communication concerning this application or proceeding.

DETAILED ACTION

Response to Arguments

1.   Applicant's arguments filed 27 January 2005 have been fully considered but they are not persuasive.

Regarding page 17, line 12 to page 18, line 15: Kawada (US Patent 5,699,499) has been clearly demonstrated to teach motion metrics on page 4, lines 6-8 of the previous office action, dated 10 August 2004. The frame interpolator and field interpolator are both taught by Campbell (US Patent 4,989,090), as demonstrated on pages 2-3 of said previous office action. Additionally, while Applicant summarizes certain aspects of the disclosed invention on page 17, lines 17-25 of Applicant's present arguments, Applicant is respectfully reminded that the determination of patentability is based on the language of the present claims. The present amendments to the claims are rejected below based on prior art. The new grounds of rejection given in detail below have been necessitated by the present amendments.

Furthermore, *Applicant alleges* that Applicant's disclosed invention works better than the combination of Campbell and Kawada. *Examiner responds* that (1) the allegation is mere conjecture since Applicant has not supported this statement with any substantive technical reasoning and (2) even *arguendo* if the disclosed invention were to work better than the combination of Campbell and Kawada, this argument does not address whether or not the *claims* patentably distinguish over the prior art. Merely stating that the disclosed invention is better is not sufficient. Applicant must demonstrate that the claims, as

presently recited, patentably distinguish over the prior art of record.

Finally, *Applicant alleges* that the median filter is not a spatial median filter and that the median filter taught by Campbell in view of Kawada does not apply to motion metric values. *Examiner responds* that the median filter taught by Kawada is clearly a spatial median filter, as understood in the art. A cited portion of Kawada states that, "assuming the block b1 to be a noted block, it may be thought to apply the Median filter to the obtained motion vectors of the block b1 and eight blocks adjacent thereto as shown shaded" [column 3, lines 5-9 of Kawada]. "[A]s shown shaded" refers to figure 3 of Kawada. The portion of Kawada cited in said previous office action therefore clearly demonstrates that the median filter taught by Kawada is indeed a *spatial* median filter.

Regarding page 18, line 16 to page 20, line 16: Again, *Applicant argues* that the presently disclosed invention works better than the combination of Campbell and Kawada. *Examiner replies* that Applicant is again reminded that the standard of patentability is whether or not the claimed invention patentably distinguishes over the prior art. Even if *arguendo* Applicant's allegation were true and the presently disclosed invention did work better than the combination of Campbell and Kawada, Applicant has still not demonstrated that the presently recited claims patentably distinguish over the prior art of record.

The full language of each claim, as presently recited, has been rejected based on prior art, as set forth in detail below. The present amendments to the claims have necessitated the new grounds of rejection that are given below.

Claim Rejections - 35 USC § 103

2.   The following is a quotation of 35 U.S.C. 103(a) which
forms the basis for all obviousness rejections set forth in this
Office action:

> (a) A patent may not be obtained though the invention is not
> identically disclosed or described as set forth in section 102 of this
> title, if the differences between the subject matter sought to be
> patented and the prior art are such that the subject matter as a whole
> would have been obvious at the time the invention was made to a person
> having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the
> invention was made.

3.   Claims 1-2, 4-18, 20-27, 29-43 and 45-50 are rejected under
35 U.S.C. 103(a) as being unpatentable over Campbell (US Patent
4,989,090) in view of Kawada (US Patent 5,699,499).

Regarding claims 1 and 26:   Campbell discloses an apparatus
(figure 2 of Campbell). Additional details of said apparatus
are further shown in figure 3, figure 6A and figure 7 of
Campbell (column 4, lines 56-58 and lines 67-68; and column 5,
lines 4-6 of Campbell).

Said apparatus further comprises a frame (interfield)
interpolator (figure 2(22) of Campbell) for yielding a frame
based luminance value for a missing pixel by using frame based
interpolation (column 6, lines 35-37 and lines 43-45 of
Campbell); and a field (intrafield) interpolator (figure 2(28)
and column 7, lines 10-14 of Campbell) for yielding a field
based luminance value for a missing pixel (figure 1(i) and
column 5, lines 29-32 of Campbell) by using field based inter-
polation (column 7, lines 10-14 of Campbell). The spatial
interpolator (figure 2(28) of Campbell) computes a spatial
average of pixels (column 7, lines 10-14 of Campbell) used to
interpolate the value of the missing pixel (figure 1(i) and
column 5, lines 29-32 of Campbell) between two known pixels

(figure 1(a,b) and column 5, lines 33-36 of Campbell) on the
same field (figure 1(F1) and column 5, lines 29-34 of Campbell).
Furthermore, the interpolated value is a luminance value of the
missing pixel since the pixel data is given as a luminance data
stream (column 7, lines 40-42 of Campbell).

Said apparatus further comprises a luminance difference
unit (figure 3(32) of Campbell) for obtaining luminance value
differences of pixels (column 7, lines 40-45 of Campbell) in
prescribed fields of an image (figure 1(F0,F2) and column 7,
lines 40-43 of Campbell) in accordance with prescribed criteria
(column 7, lines 44-45 of Campbell); and a motion detector
(figure 2 (30) and column 7, lines 38-39 of Campbell) supplied
with prescribed ones of said luminance value differences (column
7, lines 40-42 of Campbell) for generating a motion metric value
at a missing pixel (column 7, lines 53-55 of Campbell) and for
filtering said pixel differences to remove aliases under
predetermined motion conditions (column 7, lines 46-50 of
Campbell). As is well-known in the art, aliasing occurs when
the signal sampling rate is below at least twice the frequency
of the highest frequency component. This is known as the
Nyquist Criterion. By applying a low-pass filter to eliminate
any residual high frequency components that may include noise,
chroma sideband pollution, etc. (column 7, lines 46-50 of
Campbell), any potential aliasing is removed.

Said apparatus further comprises a controllable combiner
(figure 2(26) of Campbell) supplied with said frame based
luminance value (column 6, lines 54-60 of Campbell) and said
field based luminance value (column 6, lines 46-48 of Campbell)
and being responsive to a representation of said motion metric
value (column 6, lines 65-68 of Campbell) to controllably supply

as an output a luminance value for said missing pixel (column 6, lines 58-62 of Campbell), wherein said controllable combiner, in response to said representation of said motion metric value indicating the image is still, outputs said frame based (interfield) luminance value, and, in response to said representation of said motion metric value indicating motion in the image, outputs said field based (intrafield) luminance value (column 6, lines 58-62 of Campbell). As can be clearly seen in figure 2 of Campbell, when the switch (figure 2(26) of Campbell), spatial interpolator (figure 2(28) of Campbell), and motion detector (figure 2(30) of Campbell) are added to the device (column 6, lines 54-58 of Campbell), the switch determines whether the output of said spatial interpolator or the temporal median filter (figure 2(22) of Campbell).

Campbell does not disclose expressly a spatial median filter supplied with at least three of said motion metric values for determining a median motion metric value and for removing random noise from said luminance differences without creating spurious motion values.

Kawada discloses a spatial median filter (figure 1 of Kawada) supplied with at least three of said motion metric values (column 3, lines 6-9 of Kawada) for determining a median motion metric value (column 3, lines 1-5 of Kawada) and for removing random noise from said luminance differences without creating spurious motion values (column 2, lines 59-67 of Kawada).

Campbell and Kawada are combinable because they are from the same field of endeavor, namely filtering, interpolating and processing video image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art

to apply the median filter for motion vectors taught by Kawada
to the motion vector calculation and processing taught by
Campbell. Said controllable combiner would then also respond to
a median metric value instead of a single metric value. The
motivation for doing so would have been to improve motion
vectors of blocks containing boundaries of objects in different
motions to provide for satisfactory visual interpolation (column
1, line 67 to column 2, line 3 of Kawada). Therefore, it would
have been obvious to combine Kawada with Campbell to obtain the
invention as specified in claims 1 and 26.

   Regarding claims 17 and 42: The arguments regarding claims
1 and 26 are incorporated herein.

   Campbell further discloses a look-up table (figure 4 of
Campbell) including blending factor values related to said
motion metric values (column 7, lines 12-16 of Campbell) and
being responsive to supplied motion metric values for supplying
as an output corresponding blending factor values (column 7,
lines 8-12 of Campbell). The switch (figure 2(26) of Campbell)
is used to multiply the intrafield signal (figure 2(29) of
Campbell) by a control value of k, said control value being
between zero and unity, and the interfield signal (figure 2(23)
of Campbell) by (1-k) (column 7, lines 17-22 of Campbell). Said
control value is a function of the motion activity (column 7,
lines 26-29 of Campbell). Said control value is stored for a
specific number of steps, relating the motion amplitude and the
fractional value of k (figure 4 and column 7, lines 22-25 of
Campbell). Since the k values are stored in memory as a
particular number of steps relating quantities, in other words
taking the motion amplitude as an input and outputting the
corresponding value of k, then said memory storing the specific

values of k, which is accessed by the apparatus, constitutes a
look-up table.

Regarding claims 2, 18, 27 and 43: Campbell does not
disclose expressly that said spatial median filter is a nine-
value spatial median filter.

Kawada discloses a nine-value (figure 3 and column 3, lines
18-22 of Kawada) spatial median filter (column 3, lines 22-26 of
Kawada).

Campbell and Kawada are combinable because they are from
the same field of endeavor, namely filtering, interpolating and
processing video image data. At the time of the invention, it
would have been obvious to a person of ordinary skill in the art
to use a nine-value filter, as taught by Kawada, for the spatial
median filter of Campbell. The motivation for doing so would
have been improve motion vectors of blocks containing boundaries
of objects in different motions to provide for satisfactory
visual interpolation (column 1, line 67 to column 2, line 3 of
Kawada). Therefore, it would have been obvious to combine
Kawada with Campbell to obtain the invention as specified in
claims 2 and 27.

Regarding claims 4 and 29: Campbell discloses that said
frame based luminance value is generated by said frame
(interfield) interpolator in accordance with $C_0 = C_{-1}$, where C_0 is
the luminance value of the missing pixel in field f_0 and C_{-1} is
the luminance value of a pixel corresponding to the missing
pixel in a last prior field f_{-1} relative to field f_0 (column 5,
lines 40-44 of Campbell), and said field based luminance value
is generated by said field (intrafield) interpolator in

accordance with $C_0 = \dfrac{(N_0 + S_0)}{2}$, where N_0 is the luminance value of a

pixel above and in the same field f_0 as the missing pixel, and S_0 is the luminance value of a pixel below and in the same field f_0 as the missing pixel (column 5, lines 44-45 and lines 50-51 of Campbell). If there is no motion, then the luminance value of a pixel (d) corresponding to the missing pixel in a last prior field (F2) can be used to represent the missing pixel (i) (column 5, lines 40-44 of Campbell). If there is motion (column 5, lines 44-45 of Campbell), the average of the pixel above (a) and the pixel below (b) the missing pixel (i) is used (column 5, lines 50-51 of Campbell), an average being, by definition,

$i = \dfrac{(a+b)}{2}$. The use of different symbols (C_0, C_{-1}, f_0, f_{-1}, N_0, S_0)

to represent the same corresponding physical quantities (i, d, F1, F2, a, b) is simply a matter of notation.

Regarding claims 5, 12, 21, 30, 37 and 46: Campbell does not disclose expressly that said luminance difference unit generates a plurality of prescribed luminance value differences of pixels in prescribed fields of the image, and said motion detector employs prescribed relationships of said luminance value differences to generate said motion metric value.

Kawada discloses that generating a plurality of prescribed luminance value differences of pixels in prescribed fields of the image (column 3, lines 5-8 of Kawada), and employing prescribed relationships of said luminance value differences to generate said motion metric value (column 4, lines 30-32 and lines 38-45 of Kawada). A plurality of prescribed motion vectors for pixels are computed, specifically for a neighborhood of pixels (column 3, lines 5-8 of Kawada), which requires the luminance difference of said pixels.

Campbell and Kawada are combinable because they are from
the same field of endeavor, namely filtering, interpolating and
processing video image data. At the time of the invention, it
would have been obvious to a person of ordinary skill in the art
to apply multiple prescribed calculations of motion metric
values for a prescribed set of pixels, as taught by Kawada, said
motion metric values calculated using luminance differences, as
specifically taught by Campbell. The motivation for doing so
would have been improve motion vectors of blocks containing
boundaries of objects in different motions to provide for
satisfactory visual interpolation (column 1, line 67 to column
2, line 3 of Kawada). Therefore, it would have been obvious to
combine Kawada with Campbell to obtain the invention as
specified in claims 5, 12, 21, 30, 37 and 46.

Regarding claims 6, 13, 22, 31, 38 and 47: Campbell
discloses that said luminance difference unit generates the
absolute value (column 7, lines 51-53 of Campbell) of the
difference between corresponding pixel luminances in frames F0
and F2 (column 7, lines 40-44 of Campbell) in order to detect
motion (column 7, lines 29-32 of Campbell). Since the pixel to
be interpolated (i) is in frame F1 (figure 1 of Campbell), F0
and F2 therefore correspond to frames f_1 and f_{-1}, and c and d
correspond to pixels C_1 and C_{-1}. If the luminance difference for
the center pixel is denoted as Δ_c, then said luminance difference
of the frame is therefore given as $\Delta_c = |C_1 - C_{-1}|$.

Campbell further discloses that the missing pixel (i) is
interpolated as the average of the pixel above (a) and pixel
below (b) said missing pixel (column 5, lines 50-51 of
Campbell), which would therefore be given by the equation

$i = \dfrac{a+b}{2}$.   This relationship could also be expressed as

$C_0 = \dfrac{(N_0 + S_0)}{2}$, where N_0 is the luminance value of a pixel above and

in the same field f_0 as the missing pixel, and S_0 is the
luminance value of a pixel below and in the same field f_0 as the
missing pixel, since the change in variable name is a simple
matter of notation. Campbell further discloses that the video
image data is interlaced (figure 1 and column 5, lines 36-39 of
Campbell), so a corresponding pixel position in every second
frame will have to be interpolated in a similar manner.
Therefore, the spatially interpolated value for the
corresponding pixel position in the field f_{-2}, which is the

second prior field relative to f_0, is given by $C_{-2} = \dfrac{(N_{-2} + S_{-2})}{2}$,

where C_{-2} is the corresponding missing pixel in field f_{-2}, N_{-2} is
the luminance value of a pixel above and in the same field f_{-2} as
the missing pixel (C_{-2}), and S_{-2} is the luminance value of a pixel
below and in the same field f_{-2} as the missing pixel (C_{-2}).

Campbell does not disclose expressly that said luminance
difference unit generates a second luminance difference value in

accordance with $\Delta_a = \left| \dfrac{N_0 + S_0}{2} - \dfrac{N_{-2} + S_{-2}}{2} \right|$.

Kawada discloses obtaining a motion vector of a center
pixel (b1) in a block (figure 3(b1) and column 3, lines 18-22 of
Kawada).

Campbell and Kawada are combinable because they are from
the same field of endeavor, namely filtering, interpolating and
processing video image data. At the time of the invention, it
would have been obvious to a person of ordinary skill in the art
to also obtain a motion vector (luminance difference) directly

from the center pixel, as taught by Kawada. Since, as taught by Campbell, the video image data is interlaced and the center pixel of both f_0 and f_{-2} must be interpolated, the resultant motion vector (Δ_a) would be $\Delta_a = \left| \dfrac{N_0 + S_0}{2} - \dfrac{N_{-2} + S_{-2}}{2} \right|$. The motivation for doing so would have been to improve the visual interpolation field quality (column 2, lines 1-3 of Kawada). Therefore, it would have been obvious to combine Kawada with Campbell to obtain the invention as specified in claims 6, 13, 22, 31, 38 and 47.

Further regarding claims 7, 14, 23, 32, 39 and 48: Campbell discloses selecting the largest component of motion values at the vicinity of the pixel to be interpolated (i) (column 7, lines 35-37 of Campbell). For the motion vectors calculated above in the arguments regarding claims 6, 13, 22, 31, 38 and 47, this would cause said motion detector to give a resultant motion metric value (Δ) in accordance with

$$\Delta = \max(\Delta_c, \Delta_a).$$

Regarding claims 8, 15, 24, 33, 40 and 49: Campbell discloses that said luminance difference unit generates the absolute value (column 7, lines 51-53 of Campbell) of the difference between corresponding pixel luminances in frames F0 and F2 (column 7, lines 40-44 of Campbell) in order to detect motion (column 7, lines 29-32 of Campbell). Since the pixel to be interpolated (i) is in frame F1 (figure 1 of Campbell), F0 and F2 therefore correspond to frames f_1 and f_{-1}, and c and d correspond to pixels C_1 and C_{-1}. If the luminance difference for the center pixel is denoted as Δ_c, then said luminance difference of the frame is therefore given as $\Delta_c = |C_1 - C_{-1}|$.

Campbell further discloses that the video image data is
interlaced (figure 1 and column 5, lines 36-39 of Campbell), so
a motion vector will have to take into account the corresponding
pixel values in every other frame.

Campbell does not disclose expressly that said luminance
difference unit generates a second luminance difference value in
accordance with $\Delta_n = |N_0 - N_{-2}|$, where N_0 is a luminance value of a
pixel above and in the same field f_0 as the missing pixel and N_{-2}
is a luminance value of a pixel above the missing pixel and in
the second prior field f_{-2} relative to the field f_0 including the
missing pixel, and generates at least a third luminance
difference value in accordance with $\Delta_s = |S_0 - S_{-2}|$, where S_0 is a
luminance value of a pixel below and in the same field f_0 as the
missing pixel and S_{-2} is a luminance value of a pixel below the
missing pixel and in the second prior field f_{-2} relative to the
field f_0 including the missing pixel.

Kawada discloses calculating motion vectors in a center
pixel (figure 3(b1) of Kawada) and the pixels adjacent to said
center pixel (figure 3 and column 3, lines 1-5 of Kawada), which
therefore includes the pixel above and below said center pixel.

Campbell and Kawada are combinable because they are from
the same field of endeavor, namely filtering, interpolating and
processing video image data. At the time of the invention, it
would have been obvious to a person of ordinary skill in the art
to further obtain motion vectors (luminance differences) for the
pixels above and below said center pixel, as taught by Kawada.
Since, as taught by Campbell, the video image data is
interlaced, the resultant motion vectors (Δ_n, Δ_s) would be
$\Delta_n = |N_0 - N_{-2}|$ and $\Delta_s = |S_0 - S_{-2}|$. The motivation for doing so would

have been to improve the visual interpolation field quality ,
(column 2, lines 1-3 of Kawada). Therefore, it would have been
obvious to combine Kawada with Campbell to obtain the invention
as specified in claims 8, 15, 24, 33, 40 and 49.

Further regarding claims 9, 16, 25, 34, 41 and 50:
Campbell does not disclose expressly that said motion detector
generates said motion metric value in accordance with
$\Delta = \max\left(\Delta_c, \min\left(\Delta_n, \Delta_s\right)\right)$, where Δ is said motion metric value.

Kawada discloses using median filtering to determine the
motion vector to use for the center pixel, thus eliminating
large motion vectors which are the result of noise (column 3,
lines 44-50 of Kawada). For the case of using the three motion
vectors $(\Delta_c, \Delta_n, \Delta_s)$, as discussed in the arguments regarding
claims 8, 15, 24, 33, 40 and 49, said median filtering is
expressible in the form $\Delta = \max\left(\Delta_c, \min\left(\Delta_n, \Delta_s\right)\right)$.

Campbell and Kawada are combinable because they are from
the same field of endeavor, namely filtering, interpolating and
processing video image data. At the time of the invention, it
would have been obvious to a person of ordinary skill in the art
to apply median filtering, as taught by Kawada, to determine the
motion vector of the pixel to be interpolated. The motivation
for doing so would have been to reduce the effects of noise
(column 3, lines 48-50 of Kawada). Therefore, it would have
been obvious to combine Kawada with Campbell to obtain the
invention as specified in claims 9, 16, 25, 34, 41 and 50.

Regarding claims 10 and 35: Campbell discloses a look-up
table (figure 4 of Campbell) including blending factor values
related to said motion metric values (column 7, lines 12-16 of
Campbell) and being responsive to said median motion metric

value from said spatial median filter for supplying as an output
a corresponding blending factor value as said representation of
said median motion metric value (column 7, lines 8-12 of
Campbell). The switch (figure 2(26) of Campbell) is used to
multiply the intrafield signal (figure 2(29) of Campbell) by a
control value of k, said control value being between zero and
unity, and the interfield signal (figure 2(23) of Campbell) by
(1-k) (column 7, lines 17-22 of Campbell). Said control value
is a function of the motion activity (column 7, lines 26-29 of
Campbell). Said control value is stored for a specific number
of steps, relating the motion amplitude and the fractional value
of k (figure 4 and column 7, lines 22-25 of Campbell). Since
the k values are stored in memory as a particular number of
steps relating quantities, in other words taking the motion
amplitude as an input and outputting the corresponding value of
k, then said memory storing the specific values of k, which is
accessed by the apparatus, constitutes a look-up table.

    Regarding claims 11, 20, 36 and 45: Campbell discloses
that said controllable combiner is responsive to said blending
factor for supplying as an output a luminance value for said
missing pixel in accordance with $C_0 = \alpha \frac{(N_0 + S_0)}{2} + (1 - \alpha)C_1$, where C_0 is
the luminance value of the missing pixel in field f_0, C_{-1} is the
luminance value of a pixel corresponding to the missing pixel in
a last prior field f_{-1} relative to the field f_0, N_0 is the
luminance value of a pixel above and in the same field f_0 as the
missing pixel, S_0 is the luminance value of a pixel below and in
the same field f_0 as the missing pixel and α is the blending
factor (column 7, lines 17-22 of Campbell). As discussed above
in the arguments regarding claims 4 and 29, said field based

luminance value is generated by said field (intrafield) -

interpolator in accordance with $C_0 = \dfrac{(N_0 + S_0)}{2}$ (column 5, lines 44-

45 and lines 50-51 of Campbell) and said frame based luminance

value is generated by said frame (interfield) interpolator in

accordance with $C_0 = C_{-1}$ (column 5, lines 40-44 of Campbell). A

control signal (k) is used such that said field based luminance

value is multiplied by k and said frame based luminance value is

multiplied by (1-k) and the two signals are blended together

(column 7, lines 17-22 of Campbell). k can be represented by α

since the variables represent the same quantity and the choice

between k and α is therefore a simple matter of notation. The

equation for the output luminance value for the missing pixel

can therefore be represented as $C_0 = \alpha \dfrac{(N_0 + S_0)}{2} + (1 - \alpha) C_1$.

Conclusion

4.   Applicant's amendment necessitated the new ground(s) of

rejection presented in this Office action. Accordingly, **THIS

ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is

reminded of the extension of time policy as set forth in 37

CFR 1.136(a).

A shortened statutory period for reply to this final action

is set to expire THREE MONTHS from the mailing date of this

action. In the event a first reply is filed within TWO MONTHS

of the mailing date of this final action and the advisory action

is not mailed until after the end of the THREE-MONTH shortened

statutory period, then the shortened statutory period will

expire on the date the advisory action is mailed, and any

extension fee pursuant to 37 CFR 1.136(a) will be calculated

from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than

SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier

communications from the examiner should be directed to James A.

Thompson whose telephone number is 571-272-7441. The examiner

can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are

unsuccessful, the examiner's supervisor, David K. Moore can be

reached on 571-272-7437. The fax phone number for the

organization where this application or proceeding is assigned is

571-273-8300.

Information regarding the status of an application may be

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Business Center (EBC) at 866-217-9197 (toll-free).

James A. Thompson
Examiner
Art Unit 2624

02 November 2005

THOMAS D.
LEE
PRIMARY EXAMINER